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2001

document version
Early version, also known as pre-print

Faculteit der Economische Wetenschappen en Econometrie

SERIE RESEARCH MEMORANDA

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Research Memorandum 2001-4 February 2001

vrije **Universiteit** ***amsterdam***

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ABSTRACT

The aim of this paper is to review the insights on the desirability and possibilities for using economic policy instruments to reach sustainable use of water. Special attention will be paid to the scope for price instruments and privatisation and liberalisation of the sector as these feature prominently in the current policy debate. For this aim, we will provide a stylized description of the water for market devoting attention to both the relevant characteristics of demand and supply, including market failures that require government intervention to regulate the market.Next, attention is shifted to the possibilities of influencing supply and demand such that the market for water satisfies basic sustainability criteria.

INTRODUCTION

Water is of vital importance for human existence. Without sufficient and clean water, there will be a lack of fertile ground, poor hygiene, etc. The problems that can arise in the absence of sufficient and clean water are clearly visisble in many developing countries. However, also in developed countries huge efforts are required to satisfy the basic needs. It is therefore no surprise that public policy has traditionally had a serious influence on the water sector. Governments play an important role in the production of water in most countries. The central question that we will address from an economic point of view is to what extent this intensive involvement of governments can be justified. Put in economic terms, what are the market failures that justify the active role that most governments play?

The World Water Forum, recently held in The Hague, greatly aroused the interest in water issues. Some key issues that were debated there are related to the privatisation of drinking water and the possible taxes on water use. These also received much attention in the Dutch

policy debate on sustainable water use (Tweede Kamer der Staten-Generaal, 1999). This already marks an important change in the perception of water. It is increasingly considered as a scarce and normal economic good that is subject to the ordinary, basic and generally applicable laws of demand and supply. The debate also marks an important shift away from the traditional approach in which the satisfaction of any level of demand was considered to be a primary objective for public actors. However, these debates tend to lack a well-structured economic analysis of water management and related decisions. Also a fair amount of scepticism can still be witnessed against the use of insights from the economic science for a policy analysis of the water sector.

Given this state of affairs, this article will focus on the various aspects of the economics of water. First, a general analysis will be offered considering water as a 'normal' economic good with different usage functions. This is done by providing the relevant characteristics of the demand and supply of water, emphasising where relevant the peculiar characteristics of the supply and demand side of water. Having done this, we will illustrate the usefulness of economic analysis for discussing the usefulness and desirability of the application of economic instruments to steer the water sector into a sustainable direction. This is done by focusing on the tariff system and privatisation and liberalisation of the sector. The article will finish with a number of conclusions.

THE SUPPLY OF WATER

The supply of water is mainly characterised by the transportation and distribution process of water and the production process of water. The sources for the production of water are surface water sources, ground water sources or a mixture of both sources. From an economic point of view, both sources have their advantages and disadvantages. For example, in the Netherlands surface water sources are available to a very large extent. In the Netherlands , the Rhine and the Meuse rivers are used for the production of drinking water for, respectively, Amsterdam and Rotterdam. A main disadvantage is the low quality of the sources. The quality of the Rhine water was so low near the end of the sixties, that it could not be used for drinking water anymore. The increased efforts to decrease the pollution deriving from large-scale polluters and the Rhine Action Plans from 1976 and 1987 were successful in improving the quality of

the water of the River Rhine. Nevertheless, economic activities of many small-scale polluters, such as farmers located in the river basin of the River Rhine, resulted in a stagnation of the Rhine water quality. Drinking water companies that use surface water sources need considerable purification efforts, which are at least four times higher than those using ground water sources do. Although the quality of ground water sources is often high, the availability is less than surface water sources. In the Netherlands, the purification of drinking water shows major differences. For example, surface water companies in general use a large amount of chemical substances, which is often unnecessary for ground water companies.

Water is transported and distributed via a network of pipelines. This means transportation from the source to the production installation and from the production installation to the consumer. The need for a network and the huge sunk costs involved in establishing a network is of vital importance to understand the structure of the water sector. The capital costs of the network are so large, that effectively only one network is economically viable. As long as the production and transportation of drinking water is not separated from the ownership of the network, a natural monopoly results. It is well known that monopolies are sub-optimal from a welfare point of view and that in case the monopoly situation is unavoidable, regulation of the monopolist is required and a role exists for the government. One possibility which is dominantly applied throughout the world is that the government takes care of the supply of water itself. We return in the section on policy issues to the alternative possibilities of dealing with this situation from an economic optimality point of view.

DEMAND FOR WATER

The drinking-water demand is rather complex and shows much variation. Figure 1 gives an impression of the water use per capita in a number of countries. Hidden behind these aggregate figures are huge variations in demand by different user categories, Individual demand is shown in micro-studies to depend, among others, on age, ethnic or cultural background, possession of a garden, income, price, tariff structure, climate, season, etc. Most studies on water demand performed so far, however, have focused on rather aggregate issues like (a) the responsiveness of groups of actors to changes in the price of water and (b)

forecasts of aggregate water demand which are relevant for, for example, capacity decisions to be made in the industry. It is beyond the scope of this paper to discuss all ramifications of these studies on water demand. What is relevant for the remainder of this paper is the responsiveness of actors to changes in the price of water. Associated with this is the question on the optimal tariff structure. It is to these issues that we turn in the remainder of this section.

< Insert Figure 1 around here>

Price elasticities of demand

Measuring the responsiveness of consumers to price changes is done by determining price-elasticities of demand. These indicate the percentage change in demand in response to a 1% increase in the price. A plethora of studies has been done estimating these elasticities. There is an extensive methodological debate on the appropriate way of estimating these elasticities (see, for example, Hewitt and Hanemann and Dalhuisen et al., 2000). Nevertheless, a fair conclusion that can be drawn from the existing studies is that consumers do respond to changes in the price of water by reducing their demand. The average short-run elasticity that has been found is -0.41. Long-run elasticties exceed these estimates. This is a common feature of estimates of elasticities and is due to the time that is required to respond by installing water-saving appliances, etc. Figure 2 depicts the distribution of empirical estimates of the elasticity of demand for water as they have been found in the literature (see Dalhuisen et al. 2000 for an extensive analysis and an explanation of the variation of the heterogeneity in the estimates).

<Insert Figure 2 around here>

The optimal tariff structure

From an economic point of view, the structure of tariffs levied on consumers is important. Essentially, four requirements can be imposed on a tariff system for water services (Dalhuisen

et al., 2000). These requirements describe the minimum elements a pricing system should comprise under sustainability criteria:

- achieving *full* cost *recovery*, meaning that revenues should (at least) be equal to some measure of costs where – depending upon the precise cost measure – financial, social and environmental costs are incorporated;
- assuring *equity* in social (right to water), economic (economic activities) and environmental (high level of protection) terms;
- assuring efficiency in terms of economy (providing incentives to engage in water saving technologies), social (providing sufficient water but avoiding waste of water), environmental (optimal but not over exploitation of resources);
- assuring *administrative feasibility and efficiency*, concerning metering, collection of revenues, etc.

These conditions can to some extent be mutually exclusive. For example, administrative efficiency and economic efficiency are difficult if not impossible to satisfy at one and the same time. As a consequence, any tariff system has to strike a balance between these four basic requirements. In achieving an optimal situation, it is important to sketch the essence of any tariff structure. In its essence, a tariff system exists of a fixed fee (which can be negative) and a (set of) variable fee(s). In case the variable fee depends on the actual use, there is a situation of a block rate tariff. The total payments are equal to the fixed fee plus the amount consumed times the average (variable) tariff. In case of a block rate tariff, the average tariff depends on the total amount consumed. Let us consider and discuss a specific example. Consumers pay a fixed tariff equal to F. In the first block (less than 100 m3) in which they consume, they pay 1 per m3, whereas in the second block (more than 100 m3) they pay h per m3. A consumer who uses less than 100 m3 (say q) thus pays $F+lq$. A consumer using more than 100 m3 (say Q) pays $F+100l+(Q-100)h$. The average price for the first consumer is $F/q+l$, whereas for the second consumer it is $(F+100(l-h))/Q+h$. This exercise reveals several important lessons. First, if it is found to be desirable that relatively poor people with – by assumption – consume low amounts of water pay on average a low price, a negative fixed fee F can be imposed. In addition, an increasing block rate tariff can be developed ($h>l$). This is graphically illustrated in Figure 3 in which the total payments and the average price is

depicted for various cases of the fixed fee and the structure of the tariffs (i.e. increasing or decreasing block rates).

< Insert Figure 3 around here >

POLICY ISSUES

Full cost recovery

A highly advocated principle is that of full cost recovery. The proposal for a Water Framework Directive comprises a provision for a *"full cost recovery for water services"*. However, after changes resulting from political discussion in the European institutions, only a provision (Art. 9) remained saying that Member States shall *"take account of the principle of recovery of the costs of water services including environmental and resource costs"*. Also during the recent World Water Forum, there was a strong plea for full cost pricing, although it was generally recognised to be difficult to fit this into the decision-making process.

Despite these problems in implementing the principle of full cost recovery, it is important that water management is led by sound economic principles. Some examples might illustrate this. Cities in developing countries (especially the slumps) do not have a drinking water pipeline system because the costs of installation are too high a share of the public sources. This resulted in the situation that inhabitants have to buy their water from water vendors for very high prices. When these expenses would be used for the purpose of installation of a drinking-water pipeline system, the installation could in principle be profitable. Another example is the existence of olive areas. They are often supported by EU subsidies, even though the market for olives is already satisfied. Useful and clean water is lost because of irrigation, which causes difficulties in the drinking-water supply of these areas. Obviously, the combination of policy failures and external effects results in inefficient markets for water with a considerable number of distortions.

Apart from political problems of implementing the sound economic principle of full cost recovery, at a practical level, it is relevant to emphasise that the concept of full cost

recovery is difficult to operationalise. In order to determine the degree of cost recovery, it is necessary to identify the amount of subsidies being paid in support of water management and to assess and value the (environmental) externalities associated with the production and use of drinking water. In the METRON case cities subsidies were not always visible. Further, it was experienced extremely difficult to track the capital costs invested in the urban water supply systems in the past. Capital costs were not always included in the cost recovery calculation by the water suppliers, as the investments in the infrastructure were covered by the water supplier itself (e.g. Israeli water carrier). Current costs of the pipe network are also difficult to consider. Environmental costs are not included in the current price calculation of the case cities and it is often not clear how they could be measured. Therefore, a clear judgement of the degree full cost recovery that has been achieved in the case cities is not feasible.

In order to achieve the objectives that are intended to be achieved through a full cost recovery and given the previously indicated problems with operationalising the concept of full cost recovery, alternatives have to be sought. This could be the imposition of restrictions that limit the degree of exploitation of the resource. An example of such a restriction is provided by the "red line" in the Sea of Galilee, that is the maximum line to which water abstraction is legal.[1] Also in The Netherlands, constraints are imposed on the amount of water to be abstracted from the 'Bethune-Polder' and at the same time the Amsterdam Water Supply Company has an obligation to control the water level.

Privatisation and Liberalisation

The aim of the European Union is to create a single market with a free exchange of goods and competition. To achieve this objective, some sectoral markets, which traditionally were part of a state run monopoly, need to be opened to competition. This process is called *"liberalisation"*. The liberalisation of the water sector is an issue currently controversially discussed in the European Union. To achieve a liberalisation of the water sector, it needs to be opened to competition and private investment.

[1] The legal provisions have been changed in the past hydrological year due to extreme drought and lack of alternative resources, i.e. the 'red line' was changed to a lower level.

Water, in principle, can be subjected to the market discipline. However, because of the reasons mentioned above, many governments in Europe have decided to put more political pressure on the water supply. In the Netherlands, the provinces and governments own most of the shares of the water companies. The main reasons for this are the profit that a water company would have in case of privatisation and also the possible health risks that otherwise perhaps could not be checked. Here as well, several new trends can be observed. In the United Kingdom, the water companies are privatised, following the trend of the deregulating authorities. Prices are fixed for a certain period of time, with one factor that will be influenced by the retail price index of the living costs and another factor that is related to the company that shows the best performances independent of the production circumstances (according to a benchmark analysis).

In France, the network is owned by local governments or governments from the province. Water companies can sign up for a contract for a fixed period. World wide, this system has led to operating water companies which need to be efficient. Therefore, French water companies, in general will have a high level of efficiency, which is why these companies, while a concession is being granted, tend to score higher than the British companies when it comes down to the contract. Nevertheless, one disadvantage of the French system is that the national contracts are taking place on a small scale only. The scaling up in the Dutch drinking water areas shall in general lead to a plea in favour of the French system when the choice will be to admit increasing competition in the drinking-water sector. Major actors in the Dutch water-market, like the NUON, will be able to achieve more synergy advantages - as a result of vertical integration - in case of, for example, the maintenance of the network. Nevertheless, a reliable mechanism for the regulation of prices will be necessary, whereas it is also essential that it is stipulated by law which actors will be responsible for the supervision of the water supply. A committee of inspection could be established for the quality of the water and a special authority in the field of competition could supervise a fair pricing of water.

Traditionally, water supply in European Union falls under the responsibility of (local) authorities that control and execute water supply. In order to create a Single Market, Member States of the European Union agreed that public procurement in the water; energy and

transport sectors should be open to general competition[2], i.e. to private entrepreneurs. Directive 93/38/EEC, which recently is in the process of amending, regulates the procurement procedures of public authorities for water, energy and transport sectors. Today it can be observed that in some Member States (e.g. France and the UK) water supply is carried out more and more by private enterprises whereas in other Member States the supply is still mainly carried out by publicly owned entities (e.g. The Netherlands and Germany). Developments over the last decade demonstrate that besides their activities in the water sector, those private entities are becoming active in other sectors, developing themselves into so called "multi utilities" (e.g. Vivendi).

Some examples of enterprises that are former water suppliers show that with the development to multi utilities (e.g. Vivendi, Lyonaise des Eaux) the share of the total turnover covered by the water sector is diminishing. Recently, companies with a different background (e.g. the traditionally electricity based RWE) see the water sector as a new playing ground for profit making (either directly or indirectly through tying arrangements). Management approaches and values that traditionally were applied by the water suppliers risk to get changed and replaced by purely profit making concepts.

However, private water suppliers in the European Union are operating under public control. In France local authorities and in the UK local authorities and the Drinking Water Inspectorate are controlling the work of the private water services. From the UK experience it can be concluded that the existence of a regulating institution is important in the situation of privatised water supply. However, the possibilities of the regulating institution are limited. Information about the water supply network, resources and the performance of the company can only be provided by the company itself and lack a neutral quality control. The obligation to provide certain information and the verification by an independent institution would help to improve the situation. The control of necessary needs, e.g. the maintenance of the distribution network, is difficult to establish and carry out, as information from an independent side about the state of the network is not available. Investments into the network therefore depend on the policy of the supplier himself.

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[2] Member States shall take care that "... services of general economic interest . . . operate on the basis of principles and conditions which enable them to fulfil their missions", Article 16, EC Treaty.

In most parts of the European Union traditionally the water sector is managed and operated at a local level. The high investments for construction and maintenance of the distribution system and to assure access to resources of sufficient quantity and quality were provided by local authorities. With liberalisation, the sector needs to be opened for *competition* and *privatisation.*

Competitive water supply would mean that the same service could be provided by different enterprises. These should be preferably organised privately and should not receive any subsidies. One could think that a competitive water market would enable the end-user to select the water company she wants to receive drinking water from (which is currently possible in the electricity sector). Looking at examples in the UK and France, it can be observed that this is not the case. Although there are a number of private enterprises providing water supply services, each distribution area is supplied by only one single supplier. Competition in the sense that the end-user is free to select the services of a supplier that fits best his demands does not exist. The distribution network is the fixed factor that makes the water supply being a natural monopoly. Theoretically, this monopoly could accept water from competing suppliers providing water from different quality that could be fed into one and the same distribution system. However, in practice problems of mixing waters from different provenance or the supply of specific water (e.g. of a defined quality) to a specific customer are problematic and unrealistic due to technical constraints. Until now, competition is restricted to the distribution of the concession for the supply of a distribution area.

To make water supply services attractive for privatisation, private investors need to see a possibility to make profit. Public supply services that are operated under full-cost-recovery conditions are well prepared for privatisation. The Water Framework Directive gives legal ground to prepare public water supply complying with the cost recovery provisions. The METRON experiences show that due to the multiple interference of this sector with other activities, it is extremely difficult to demonstrate full cost recovery of water supply. Full cost recovery does not yet assure profit making. An important element is the distribution network. The financing of the networks today often is difficult to track. Often with the support of subsidies (e.g. European structural fund) these constructions were realised. Full compensation for the network at its real cost by a private investor would reduce his profit drastically. Compared to the share of the network, the margin to make profit with water supply alone is

very small. Without the burden to compensate for the network, the margin to make profit with distributing water is much bigger. The same is true for the installations (well, pumps, protection perimeter etc.) that are necessary for the abstraction, purification and conditioning of the crude water. For private investors it is therefore more interesting to focus only on the generic supply of water. The costly network, its maintenance, wells and abstraction facilities are seen as a burden.

Privatisation of water supply is highly interesting especially for big enterprises. The privatisation of water services for multi-utilities is an opportunity to complete their selection of services. This, on the one hand, can be convenient for the end-user that prefers receiving different services from the same provider, standing for a known quality, reliability, and experience. On the other had for the supplier synergism arise in management, maintenance and control of the systems (water tubes, telephone and electricity cables positioned at the same place of the street). Internal cross-subsidies – hardly controllable by a regulating institution - can be practised, especially in the initial phase of the acquisition of a new service (as is done, for example, by Vivendi).

Without effective legislation and control the current development of liberalisation of the water sector would lead to:

- Purely economic exploitation of resources,
- Disregard of supply networks,
- Creation of private public services monopolists,
- Internal trans-sectoral cross subsidies in order to combat competitors.

However, and in order to avoid such a situation, it seems to be necessary to ensure the control by an independent public institution. The role of such an institution would be to obtain all information necessary to assess the economic, environmental and social performance of the enterprise and the compliance with all legal requirements. The experience in the UK demonstrates that a control is difficult to establish.

PRACTICAL EXPERIENCE

From a project in which several European cities have been compared, several interesting lessons can be learned related to the economics of water use. The experiences from the METRON case cities concerning "water pricing" allow the following conclusions:

1. Water pricing is an economic instrument that is already used for different purposes in different variations. Full cost-recovery is not always the aim and can not always be proven.

2. Prices are set more related to political decisions (see the UK regulator), rather than as a consequence of economic needs and rationale.

3. Water charges are used together with other management instruments in order to steer water consumption (for example, awareness campaigns, water saving technologies etc.). The popular belief that such measures are deemed to be ineffective due to inelastic demand can be contested. Empirical studies rather systematically reveal to consumers do respond to price changes. Also the introduction of metering (and therefore the introduction of economic incentives to economise on water use) turns out to be effective in reducing water demand.

4. In preparation of privatisation, the production and provision of water services needs to be an economically viable activity. No (implicit) subsidies should be paid and at least a situation of service full-cost-recovery has to be achieved without any flow of subsidies. To make it attractive for private investors it is even necessary that profit making can be expected (i.e. they should be allowed to charge sufficiently high prices). Otherwise, they will invest their money in other sectors where they can earn a decent profit.

CONCLUSIONS

This article should be regarded as an argument for an elaboration of the economic analysis within the public and private decision-making with regard to water use and production. We have tried to identify some of the key lessons that can be learned from an economically oriented view on the water sector. Some peculiarities of water were identified to justify a role for the government. Regarding the desirability and usefulness of the application of various

policy instruments, much knowledge still has to be accumulated. Useful research could go in various directions. Detailed micro-studies describing the water use and the composition of water use of individuals and the responsiveness of individuals to, for example, price changes will contribute to a better understanding of the scope and effectiveness of policy instruments aimed at reducing per capita water demand. Much more information is definitely needed on the effects of privatisation and liberalisation, the possibilities for introducing competition along different lines, and the possibilities for an effective control of the sector once it is privatised solving difficult issues related to asymmetric information, misuse of market power, etc.

The final conclusion is that the supply and demand of water is a complex matter. A justified price setting is no sinecure. Moreover, in most cases there is a linear relation between the water from the network and the amount of wastewater, which might in principle allow for an incorporation of charges for wastewater in the pricing system. In this way greater efficiency, more transparency, and a better co-ordination can be achieved through a water board, which would lead, among others, to a so-called integrated water bill, as it is used in some countries (for example in Denmark). In various countries there already have been proposals for projects which would combine the water consumption, the refuse collection rate and the surface water tax for the purification of the surface water all on one bill. If the consumer would only have to pay for the water consumption and the refuse collection rate ('small water bill'), the level of the bill would be depending on the amount of water use. If, on the other hand, there would be the combination of all three, - water consumption, refuse collection rate and the surface water tax, ('broad water bill') - , the costs for the purification of the water would also be depending on the consumption. The latter, however, is more complicated and may also lead to duplication of taxes. Plans to execute this in the Netherlands have been temporarily, as owners of houses in one county would not be treated equally in case of this experiment. Most likely, so far the last word about this matter has not been said in Europe. As should be clear from the previous exposition, there are more and more initiatives for a more economic-based view in order to achieve a more appropriate water management, but in the near future clear success can only be expected to a very limited degree. Decisions on the basis of a sound economic analysis will, in principle, take into account the growing scarcity in a more responsible way.

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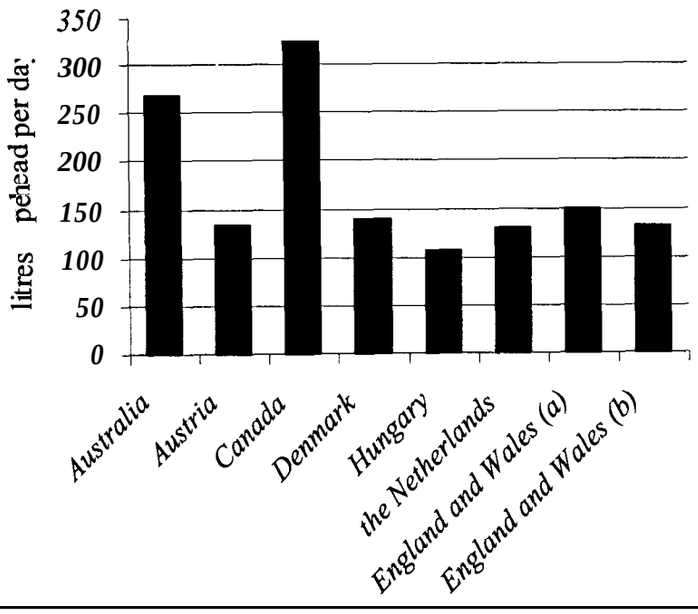
Figure 1. Estimated water use per capita per day



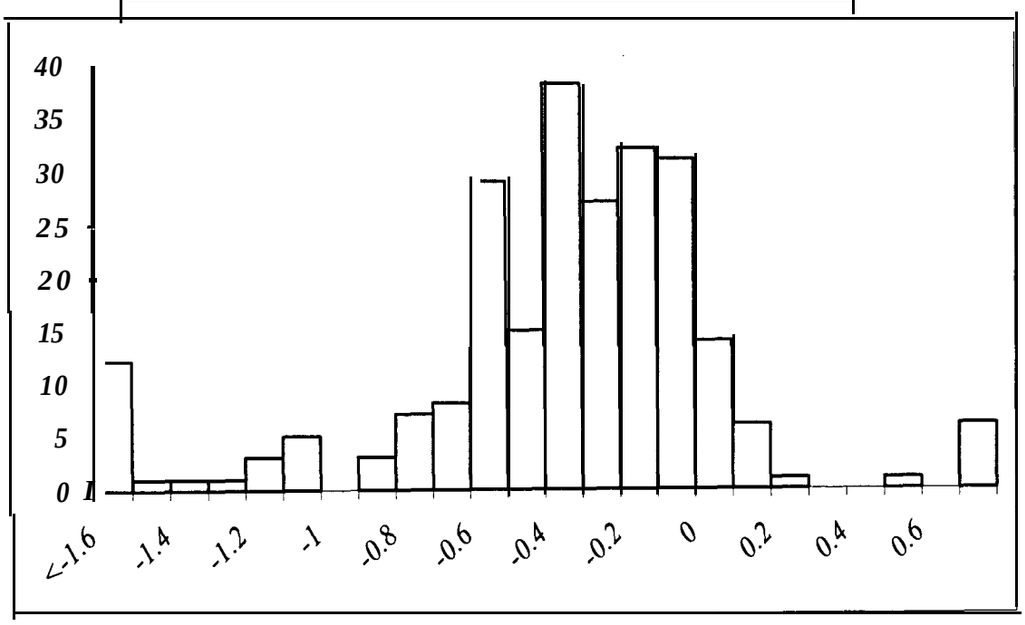


Figure 2. The Distribution of Price Elasticities of Water Demand found in 70 Studies (source Dalhuisen et al., 2000)

Figure 3a. Negative fixed fee, incr. block rates

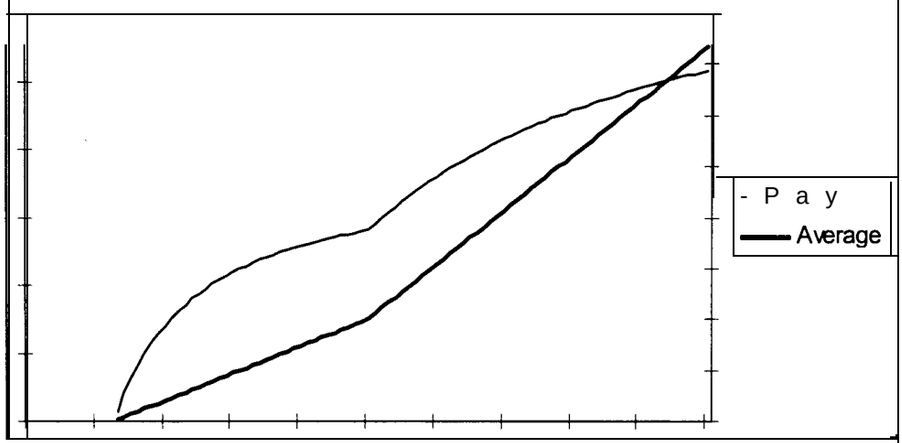


Figure 3b. Positive fixed fee, incr. block rates

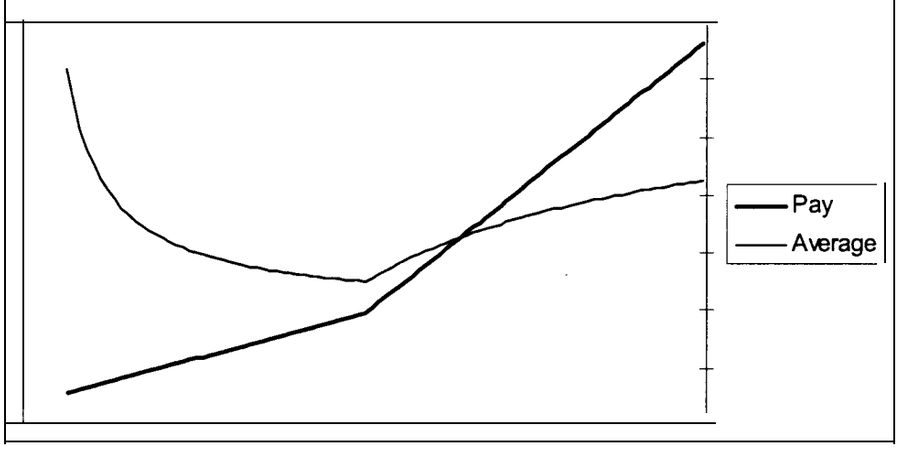


Figure 3c. Positive fixed fee, decr. block rates